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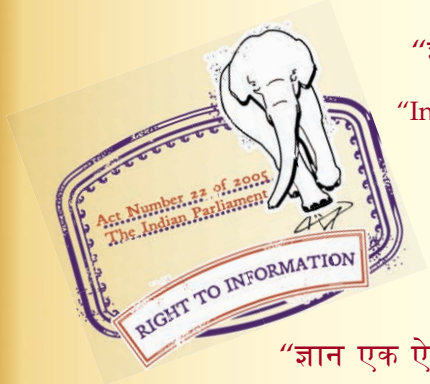
IS 11174 (1984): Aromatic polyamide paper covered rectangular and square copper wires with temperature index 200 [ETD 33: Winding Wire]

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"Knowledge is such a treasure which cannot be stolen"

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IS : 11174 - 1984

( Reaffirmed 2005 )

*Indian Standard*

# SPECIFICATION FOR AROMATIC POLYIMIDE PAPER COVERED RECTANGULAR AND SQUARE COPPER WIRES WITH TEMPERATURE INDEX 200

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**INDIAN STANDARDS INSTITUTION**
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 3

*June* 1985

# *Indian Standard*

# SPECIFICATION FOR AROMATIC POLYIMIDE PAPER COVERED RECTANGULAR AND SQUARE COPPER WIRES WITH TEMPERATURE INDEX 200

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# *Indian Standard*

# SPECIFICATION FOR AROMATIC POLYIMIDE PAPER COVERED RECTANGULAR AND SQUARE COPPER WIRES WITH TEMPERATURE INDEX 200

## 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 26 November 1984, after the draft finalized by the Winding Wires Sectional Committee had been approved by the Electrotechnical Division Council.

**0.2** This Indian Standard covers aromatic polyimide paper covered copper conductors suitable for temperature index 200.

**0.3** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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## 1. SCOPE

**1.1 General** — This standard relates to aromatic polyimide paper covered rectangular and square copper conductors suitable for temperature index 200.

**1.2 Sizes** — The requirements of this standard are applicable to conductors having thickness from 0·80 up to and including 4·00 mm and width from 3 mm up to and including 13 mm. A schedule of preferred sizes is given in IS : 6160-1971†.

## 2. TERMINOLOGY

**2.0** For the purpose of this standard, the following definitions shall apply.

*Rules for rounding off numerical values ( *revised* ).
†Specification for rectangular conductors for electrical machines.

**2.1 Wire** — The insulated material as received.

**2.2 Conductor** — The bare metal after removal of the covering.

**2.3 Increase in Dimension Due to Covering** — The difference between the thickness over the tape covering and the thickness of the conductor.

**2.4 Tolerance** — The permissible divergence of an actual magnitude from that prescribed.

## 3. GENERAL TEST CONDITIONS

**3.1** Unless otherwise specified all tests shall be carried out within a temperature range of 15 to 35°C and a relative humidity range of 45 to 75 percent. Before measurements are made, the specimens shall be preconditioned under these atmospheric conditions for a time sufficient to allow specimens to reach stability.

**3.2** The wire to be tested shall be removed from the packaging in such a way that the wire should not be subjected to tension or unnecessary bends.

**3.3** Before each test sufficient wire shall be discarded to ensure that any damaged wire is not included in the test specimens.

**3.4** When no specific range of sizes is given for a test, the test is applicable to all sizes.

## 4. CONDUCTOR

**4.1** The conductor shall conform to **3.1** of IS : 6160-1971*.

## 5. AROMATIC POLYIMIDE PAPER

**5.1** The aromatic polyimide paper used for covering shall meet the requirements given in Table 1.

## 6. APPLICATION OF PAPER COVERING

**6.1 General** — Before covering, the conductor shall be completely free from surface defects like burrs, copper dust, etc.

### 6.2 Arrangement of Layers

**6.2.1** The paper may be applied in single, double or multiple layers as agreed to between the manufacturer and the user.

*Specification for rectangular conductors for electricals machines.

**TABLE 1 REQUIREMENTS OF AROMATIC POLYIMIDE PAPER**

( *Clause* 5.1 )

| Sl No. | Property | Unit | Requirement | Test Method [ Ref to Cl No. IS : 9335 ( Part 2 )-1981* ] |
|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) |
| i) | Thickness | mm | 0·05 ± 0·005 | 3·1 |
| ii) | Substance ( mass/m², basis weight or grammage ) | g/sq metre | 40 ± 4 | 4 |
| iii) | Apparent density | g/m³ | 0·8 ± 0·02 | 5 |
| iv) | Elongation ( *Min* ) | percent | MD 7<br>CD 7 | 6 |
| v) | Tensile strength ( *Min* ) | kN/m width | MD 3<br>CD 1·5 | 6 |
| vi) | Elmendorf tear ( *Min* ) | N | MD 0·7<br>CD 1·2 | Appendix A |
| vii) | Shrinkage at 330°C ( *Max* ) | percent | MD 8·1<br>CD 1·3 | *See* Note |
| viii) | Dielectric strength ( *Min* ) | kV/mm | 16 | 22 |

MD = Machine direction.

CD = Cross machine direction.

Note — Three test pieces 250 × 250 mm shall be heated in an oven at 330°C ± 5 for 40 to 45 minutes. Test pieces shall be suspended vertically, with clamps or light weights on bottom edge to prevent curling during heating. Condition in accordance with 2.3 of IS : 9335 ( Part 2 )-1981* before and after heating and make measurements on conditioned pieces. The difference in length will be considered and percentage reported ( Maximum Value ) on the basis of length of normal test piece.

*Specification for cellulosic papers for electrical purposes: Part 2 Methods of test.

**6.2.2** For multilayer paper covering, all bottom layers shall be arranged in butt lap with successive staggering of about 30 percent with minimum of 3 mm. The top layer shall have at least 25 percent overlap. All layers shall be applied in the same direction. All layers may also be applied in the same direction with successive staggering. Every layer shall have 40 to 50 percent overlap.

**6.2.3** In case of double layer, each layer shall be applied in opposite direction with minimum of 25 percent overlapping.

**6.2.4** The nominal thickness of paper tape shall be 0·05 mm and the width of tape shall not be more than 1·5 × ( width + thickness ) of conductor.

## 7. INCREASE IN THICKNESS DUE TO COVERING

**7.1 Increase in Dimensions** — The increase in dimensions due to covering shall not exceed that specified by the purchaser nor shall it be less than that specified by more than the appropriate tolerance stated in Table 2.

TABLE 2 TOLERANCE ON COVERING

| Increase Due to the Covering | Negative Tolerance (Percent) |
|---|---|
| mm | |
| 0·25 to 0·50 inclusive | 10 |
| Over 0·50 up to and including 1·25 | 7·5 |
| Over 1·25 | 5 |

**7.2 Measuring Equipment** — The measurement shall be made with an accuracy better than 0·002 mm. If a micrometer is used, it shall be ensured that the measuring force is in the range of 0·75 to 3·0 N. Alternatively, a force of 1 to 3 N may be used.

The spindle and the anvil of the micrometer shall have a diameter of 5 to 8 mm.

### 7.3 Measuring Method

**7.3.1** *Overall Dimensions* — Measurements shall be made of the smaller dimension of the covered conductor at three positions not less than 100 mm apart. The measurements shall be made on completely straight parts of the wire. The measurement shall include at least one overlap.

Where the larger dimension of the covered conductor is greater than the diameter of the micrometer spindle, measurements shall be made at the center of the wire.

The average of the three results shall be reported as the 'overall thickness'.

**7.3.2** *Conductor Dimensions* — The covering shall be removed by any method which does not damage the conductor for the three positions used for measurements in **7.3.1** and the conductor dimension measured at these positions.

The average of the three results shall be reported as 'conductor thickness'.

**7.3.3** *Increase in Dimensions Due to Paper Covering* — The difference between the overall thickness and the conductor thickness shall be reported as the increase in thickness.

NOTE — The measurement across the larger dimension is under consideration.

## 8. ELECTRIC STRENGTH

**8.1 Method of Test** — Five electrodes shall be prepared by application of aluminium foil of 6 mm width to a straight portion of the wire. The aluminium foil shall be applied tightly. The minimum distance between the two electrodes shall be 50 mm.

**8.2 Requirement** — At least four out of five samples tested shall withstand a test for electric strength at 10 kV ( rms ) per mm ( minimum ) and fifth at minimum electric strength test at 50 percent of this value calculations.

**8.3 Calculation** — The breakdown voltage per mm thickness shall be calculated on the basis of minimum radial thickness of covering on one side.

## 9. MANDREL WINDING TEST

**9.1** Samples of aromatic polyimide paper covered conductors shall be bent flatwise through 180° round a mandrel having a diameter 6 times the bare thickness of conductor. When so tested the covering shall not open sufficiently to expose the conductor of the inner layer to view when examined under diffused light by normal eyesight.

## 10. PACKING AND MARKING

**10.1** The wire shall be tightly and evenly wound on drums complying with IS : 2069-1981*.

**10.1.1** The wire on each reel shall be in continuous length.

**10.2** The label which is to be securely attached to the drum shall have the following information:

a) Manufacturer's name or trade-mark,
b) No. of layer of covering,
c) Conductor dimension,
d) Increase in dimensions due to covering,
e) Weight of wire ( gross and net ), and
f) Lot No. and/or Batch No.

*Specification for drums for covered winding wires and strips for electrical purposes ( *first revision* ).

**10.2.1** The label may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution ( Certification Marks ) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

# APPENDIX A

( *Table* 1 )

## TEARING RESISTANCE

### A-1. GENERAL

**A-1.1** The tearing resistance is usually greater in the cross direction than in the machine direction.

### A-2. EQUIPMENT

**A-2.1** Ballistic type of tear-tester, such as the Elmendorf, is recommended. The machine is provided with two clamps, the one fixed and the other carried on a sector-shaped pendulum, suspended from a column by means of a frictionless bearing located near the apex of the sector. On releasing the pendulum, the center tongue is subjected to the load of pendulum recorded through a spring loaded friction pointer on the circumferential scale marked on the pendulum.

### A-3. TEST PIECE

**A-3.1** Accurately cut the test piece with a template in such a manner that two parallel slits from a centre tongue giving a double tear. At least one test piece in each direction shall be taken from each specimen.

### A-4. PROCEDURE

**A-4.1** Hold outer tongues of the test piece in a fixed clamp and the centre tongue in the movale clamp. Release the pendulum and note the load necessary to continue the tear. The tests may be made either on a single test piece or in packs of two or more test pieces so adjusted that the reading is not less than 25 percent and not more than 75 percent of the capacity of the instrument. The tearing resistance shall be tested separately for machine and cross direction.

## A-5. REPORT

**A-5.1** Report the average, maximum and minimum of the readings in each direction separately and state the number of test pieces used for each determination.

## A-6. TEAR FACTOR

**A-6.1** Used for comparing two papers with regard to their tearing strength and is calculated as follows:

$$\text{Tear factor} = \frac{\text{Tearing resistance}}{\text{Substance}} \times 100$$

NOTE — Elmendorf tear test method has been taken from **12.7** of IS : 1060 ( Part 1 )-1966 Methods of sampling and test paper and allied products, Part 1 ( *revised* ).

# INTERNATIONAL SYSTEM OF UNITS ( SI UNITS )

**Base Units**

| Quantity | Unit | Symbol |
|---|---|---|
| Length | metre | m |
| Mass | kilogram | kg |
| Time | second | s |
| Electric current | ampere | A |
| Thermodynamic temperature | kelvin | K |
| Luminous intensity | candela | cd |
| Amount of substance | mole | mol |

**Supplementary Units**

| Quantity | Unit | Symbol |
|---|---|---|
| Plane angle | radian | rad |
| Solid angle | steradian | sr |

**Derived Units**

| Quantity | Unit | Symbol | Definition |
|---|---|---|---|
| Force | newton | N | 1 N = 1 kg.m/s$^2$ |
| Energy | joule | J | 1 J = 1 N.m |
| Power | watt | W | 1 W = 1 J/s |
| Flux | weber | Wb | 1 Wb = 1 V.s |
| Flux density | tesla | T | 1 T = 1 Wb/m$^2$ |
| Frequency | hertz | Hz | 1 Hz = 1 c/s (s$^{-1}$) |
| Electric conductance | siemens | S | 1 S = 1 A/V |
| Electromotive force | volt | V | 1 V = 1 W/A |
| Pressure, stress | pascal | Pa | 1 Pa = 1 N/m$^2$ |